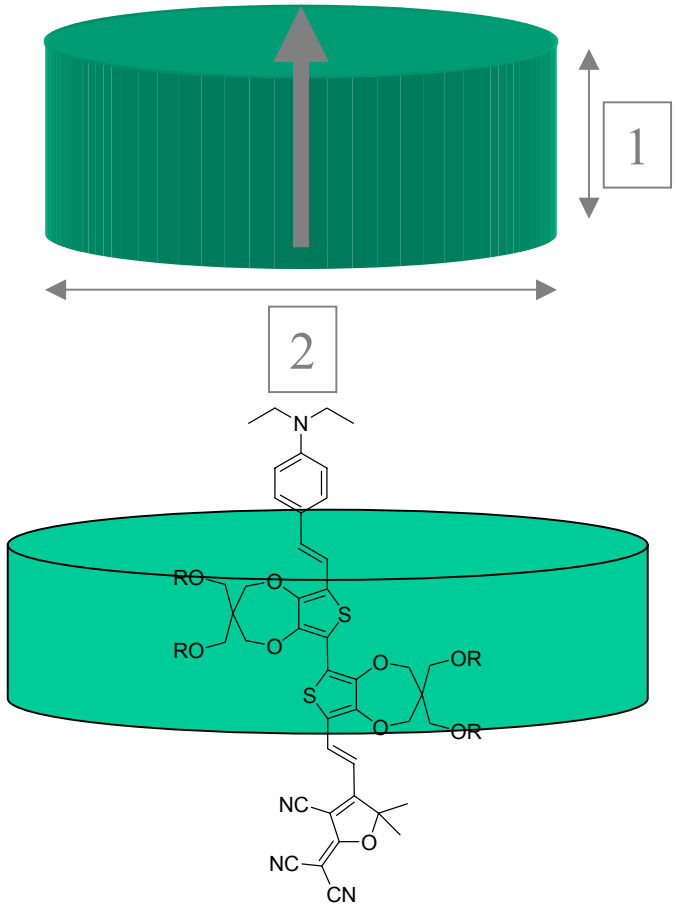
Development of Next Generation Electroactive Materials

Larry Dalton, University of Washington, DMR-0092380

Quantum and statistical mechanical calculations have guided the design and synthesis of novel electro-optic (EO) materials exhibiting an order of magnitude greater EO activity than the current best commercial material (lithium niobate). These new materials permit the fabrication of a wide range of low drive voltage (low power consumption), high bandwidth devices. Conformal and flexible devices have been produced. The production of devices by soft lithography (printing) has been demonstrated raising the potential for low cost, mass production.

Theoretical paradigms suggest that electro-optic activity can be further increased to values between 300-1000 pm/V, which would further increase application possibilities.

This design paradigm has also led to record charge mobility in organic materials relevant to organic electronics and photovoltaics.



Statistical mechanical computations indicate that a 2-to-1 molecular axes ratio leads to optimum EO activity. A dendritic implementation is shown.

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Education:

Educational activities related to this program include lectures at the NSF-sponsored workshop on sensor science & technology at Alabama A&M, the NASA Space Grant REU program at UW, the Frontiers in Nanotechology Course (a core course in the Nanotechnology Ph.D. program) at UW, a tutorial at the AAAS 2004 annual meeting, and REU lectures at UW in the summer of 2004. REU students have been recognized by university-wide awards and high school seniors have gone on to outstanding performance at universities such as Stanford and in the Putnam (mathematics) competition.

Knowledge Transfer:

Chapters in *Encyclopedia of Modern Optics* and *Kirk-Othmer Encyclopedia of Chemical Technology*. Edited special issue of the *Journal of Physical Chemistry*. Eastman Lecture at the University of Akron. Special symposia at GE Global Research and Intel. Organized AAAS Symposium on 21st Century Photonics.

Impact:

Boeing, Intel, Lumera, and other corporations are pursuing extensions of the research reported here and significant commercial impact could be forthcoming. Organic chemistry graduate student, Daniel Casmier, will join Intel this Fall. This research is feeding into several Federal research initiatives and research programs at Federal laboratories.